Responsibilities for Flood Forecasting and Warning

Ontario

Ministry of Natural Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

FLOOD FORECASTING AND WARNING IN ONTARIO

EXECUTIVE SUMMARY

In this system the Ministry of Natural Resources (MNR) has the mandate to be "lead agency". It is therefore MNR's function to define the system requirements, define and delegate responsibilities to agencies within the system and to develop and execute a strategy for implementation.

The main components in the Province's Flood Forecasting and Warning System are:

(1) Data Collection and Management

(2) Streamflow Forecasting

(3) Flood Event Communication

(4) Flood Event Operations

The major roles for the parties in the system are:

(A) CAWMB-MNR -
- design approval and maintenance of the basic data collection system and archiving.
- early alerts of major precipitation events.
- interpretation of precipitation, and runoff forecasting.
- research and development.
- consultation.
- staff training.

(B) MNR Regions (where no C.A.) or CAs
- construction of the local data collection network and maintenance over and above the basic system.
- interpretation of local factors affecting flooding including localized weather patterns, ice jams etc.
- operation and maintenance of water control structures.
- implementation of flood warnings to local municipalities and the affected public.

(C) Municipalities or MNR Districts (where no municipalities)
- receive flood warning and warn area residents.

Implementation will occur in an incremental manner as financial and technical capabilities are developed. Cost implications vary, but are not major and can be accommodated within the work planning process.

RESPONSIBILITIES

FOR

FLOOD FORECASTING AND WARNING

IN ONTARIO

June 12, 1984

I INTRODUCTION

(a) General

After Hurricane Hazel in 1954, the Province hired a hydrometeorologist and assumed the responsibility for flood forecasting and warning. In the following years, the evolving forecasting and warning system grew in size and sophistication.

In the existing system there are parties with capabilities in water resources management which range from highly developed to minimal. The object of this paper is to present a goal for a mature system, in a time frame of five years. The document outlines the requirements for a system of flood forecasting and warning, and further designates the roles and responsibilities of the parties within the system including: the flood plain resident, municipality, conservation authority and ministry.

The Ministry recognizes the importance of Conservation Authorities, where they exist, as key agencies in the management of water resources, and as an extension of municipalities within a watershed. Their role will be to maintain flood warning systems. In areas without

Conservation Authorities, the Ministry will deal directly with municipalities, and in territories without municipal organization, the Ministry will organize and deliver the warning and response.

The response to a flood emergency is excluded from this paper and is discussed in a separate document.

(b) Consequences of Neglecting Mandate

Neglect of the "lead agency" mandate could have legal, economic and social repercussions.

(i) Legal

Flood threats and occurrences, both major and minor, average 20 per year in Ontario. The Province has the responsibility for water management. It would be severely criticized or held liable for not being prepared for flood threats and emergencies.

(ii) Economic

Floods cause property damage, with resulting costs to the property owner and taxpayer. This cost will escalate with increasing development and population.

Floods also cause disruption of business.

(iii) Social

The social consequences include an increased risk of loss of life and disruption of social patterns.

(c) Lead Agency Role

The Ministry of Natural Resources has been assigned the lead role for flood emergencies, commencing January 1, 1976 by Order-in-Council No. 1487/75.

Within the Provincial System of flood forecasting, and warning, it is MNR's function as lead agency to:

(i) define system requirements

(ii) define and delegate responsibilities to agencies within the system, liaise with and negotiate the role of other ministries.

(iii) develop and execute an implementation strategy.

II PROPOSED SYSTEM REQUIREMENTS

The following components are considered essential for a viable "Streamflow Forecasting - Warning System":

(a) Data Collection and Management

(b) Streamflow Forecasting

(c) Flood Event Communication

(d) Flood Event Operations

A discussion and summary of each component are presented below.

A. Data Collection and Management

Accurate and timely data is the basis of the whole system. Flood predictions are only as reliable as the data they are based on. There are five activities under this component:

(i) Establishment and maintenance of a data observation network

(ii) Weather forecasts

(iii) Data Collection/Co-ordination/Transmission

(iv) Data archiving

(v) Training

Extensive observation networks are required so that ground conditions, precipitation, temperature, wind, evaporation, radiation, and streamflow can be monitored.

Weather forecasts are a requirement for "early alert" of a potential flood threat and for the management of a flood event.

A centre is required at which all data from observation networks are collected, co-ordinated and made available to client groups.

Data archiving includes abstracting, formatting and filing in a manner that allows easy retrieval. It is considered essential for forecasting purposes.

Training may be required in various aspects of instrumentation, data collection methods, archiving and retrieval.

B. Streamflow Forecasting

Forecasting models are the tools for making flow predictions. Development and management of these models are important requirements in the proposed system. Existing manual and computer forecasting models must be assessed. New models should be developed where needed, and all models must be maintained.

Streamflow forecasting involves the interpretation of ground and weather data to predict runoff (rainfall excess), followed by hydrograph forecasting (flow rates at a particular time and at a particular point of interest) and stage (flood level) and damage forecasts. The information would assist effective reservoir operations and decisions on evacuation, removal of goods, sandbagging and other emergency actions.

In summary, this component comprises the following activities:

(i) Development and Management of Models

(ii) Runoff Forecast

(iii) Hydrograph Forecast

(iv) Stage/Damage/Operation Forecast

C. Flood Event Communication

The rapid transfer of data and information regarding an impending flood event is of the utmost importance to the success of the system. It is more critical in Ontario because, in most populated watersheds, the available time for emergency actions prior to the occurrence of a flood peak is relatively short, due to the length of the rivers.

In the past, communication was by telephone and telex. However, present day computer based systems allow for much faster transfer of information.

It is essential to have an early alert to advise agencies with the responsibility of developing hydrograph forecasts of impending threats from a weather system.

In turn, these agencies develop flow forecasts and, if there is a significant flood threat, issue flood warnings.

The flood event is monitored, and notices are issued. Notice may also be given of the passing of the event.

Component activities include:

(i) Early Alert (Making the field agency aware that an important storm is pending)

(ii) Flood Warning (After a forecast has been made for a flood damage centre, informing the municipality or other appropriate agency of what to expect)

(iii) Flood Event Monitoring and Information Exchange

(iv) Notice of Event Termination

D. Flood Event Operations

During an event, certain operations must be undertaken.

Once a warning is given or a flood is evident, self-help must be employed wherever possible. Families and goods should be removed from threatening flood waters. During the flood event, flood control structures must be operated.

Where municipalities feel that certain operations, which are normally the responsibility of the corporation, are best carried out by an agency such as a conservation authority; e.g., ice management, the

work may be contracted out with the cost borne by the municipality.

Activities of this component include:

(i) Self-help;

(ii) Operation of Flood Control Structures;

III RESPONSIBILITIES OF PARTIES WITHIN THE SYSTEM

Responsibilities of the parties described in this report are those of a fully developed or "mature" system. The goal of the mature system is to have all parties with highly developed capabilities.

It is recognized that this goal may not be achieved for several years and perhaps, even then, not in total. In some sparsely populated areas with minimal flood problems, only an elementary system is required. In the transition to a mature system, the CAWM Branch will continue to operate under the existing system until the designated agencies of the proposed system develop the required capabilities. Standards for a technical review are to be developed to verify these capabilities. The attached tables on pages 16, 17, 18, 19 outline the proposed responsibilities of the various parties within the mature system.

(a) Synopsis of Responsibilities

(i) Conservation Authorities and Water Management Branch (CAWMB)

The Conservation Authorities and Water Management Branch will be responsible for planning or assisting Conservation Authorities and MNR Regions in planning for the establishment of observation networks and a communication system that will rapidly collect and exchange data and information with field agencies. The Branch will coordinate a maintenance and data archiving program.

The CAWM Branch will give an "early alert" of threatening weather systems, monitor them and forecast the runoff, which may be modified in the field due to local conditions.

In addition, it will be responsible for setting standards and criteria for various components of the system and recognizing regional differences, developing and maintaining forecast models. The Branch will play a lead role in providing consulting services on all aspects of the proposed system to field agencies and training in certain fields.

(ii) Conservation Authorities or MNR Regions outside of Conservation Authorities.

These groups, in conjunction with the CAWM Branch, will be primarily responsible for the construction of data networks. In cases where the Authority or MNR Region has its own network, maintenance of it will be the responsibility of the Authority or Region. They will monitor, exchange and ensure the quality of data. Other networks are the responsibility of the individual agency such as Atmospheric Environment Service, Water Survey, and Ministry of the Environment.

Other prime responsibilities include hydrograph prediction, issuing of flood warnings, and the operation of flood control structures. It is imperative during a flood event that close liaison is maintained between the Conservation Authorities, Regions and the Conservation Authorities and Water Management Branch.

(b) Principal Changes from Present System

The need for changing the present system are four-fold. There is a desire for field agencies to take a more positive role in water management, and this is an opportunity to become familiar with the workings of a

hydrologic system. Fuller and more accurate predictions of events are the expectation of the public. Constraints limit the resources for operating a centralized system. Recognition is given of the status of the more advanced field agencies, and the mature state for others to aim for.

The principal changes from the present system include:

(i) Field Agencies

- Greater responsibility for flood forecasting by Regions and CAs, including model calibration, calculation of flow hydrographs and stage/damage forecasts at flood susceptible centres.

- CAs or MNR Regions have sole responsibility for initiating local flood warnings to municipalities and MNR Districts.

(ii) CAWM Branch

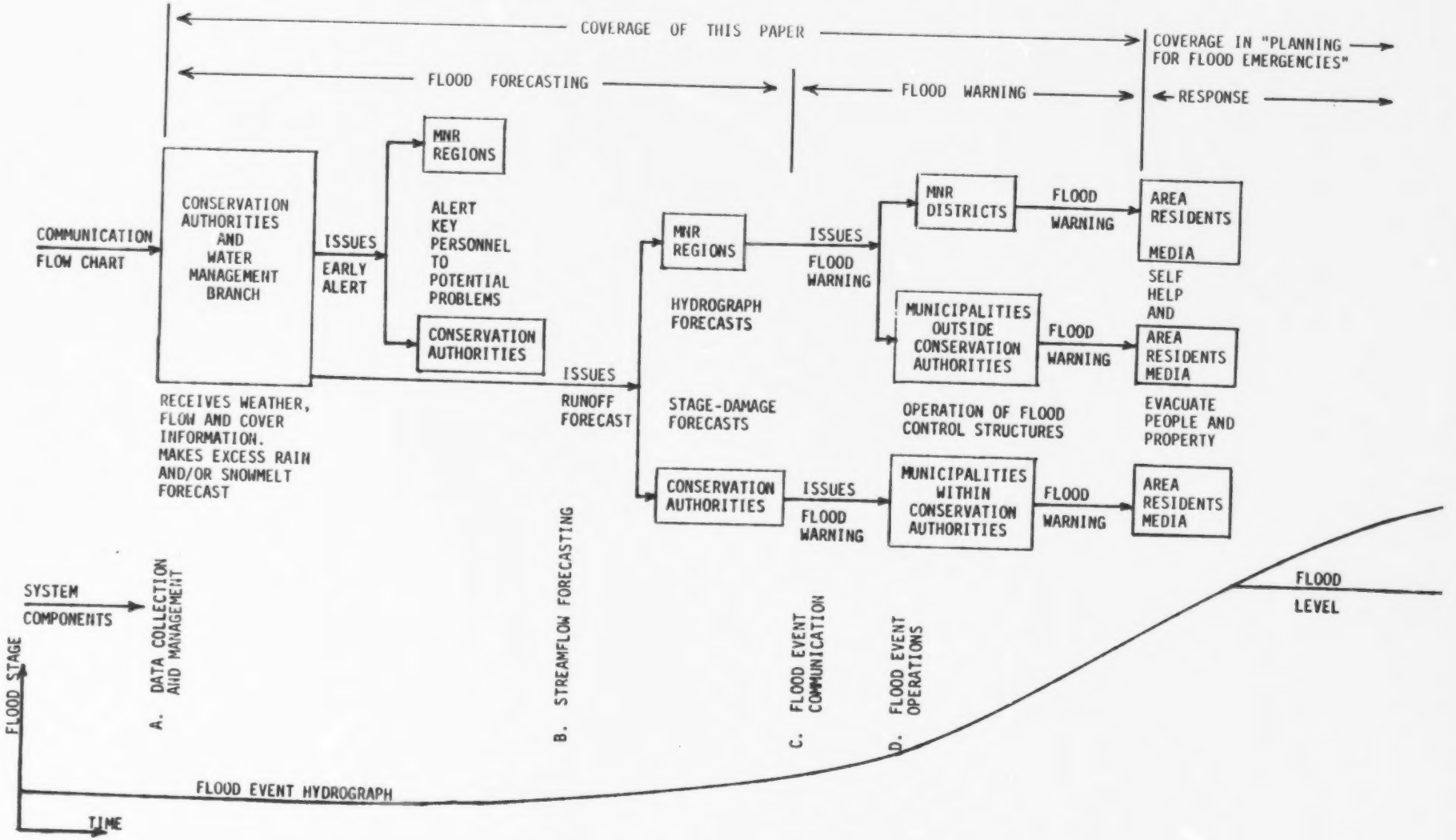
- Provincial master plan, criteria and standards for an improved observation and data collection network.

- Improved communications network for weather, early alert data and information exchange.

- Improved forecasting capability.

- Research in, development and management of forecast models.

- To offer training programs.


COVERAGE OF THIS PAPER
COVERAGE IN "PLANNING FOR FLOOD EMERGENCIES"
FLOOD FORECASTING
FLOOD WARNING
RESPONSE
COMMUNICATION FLOW CHART
CONSERVATION AUTHORITIES AND WATER MANAGEMENT BRANCH
RECEIVES WEATHER, FLOW AND COVER INFORMATION. MAKES EXCESS RAIN AND/OR SNOWMELT FORECAST
ISSUES EARLY ALERT
MNR REGIONS
CONSERVATION AUTHORITIES
ALERT KEY PERSONNEL TO POTENTIAL PROBLEMS
ISSUES RUNOFF FORECAST
MNR REGIONS
HYDROGRAPH FORECASTS
STAGE-DAMAGE FORECASTS
CONSERVATION AUTHORITIES
ISSUES FLOOD WARNING
MNR DISTRICTS
MUNICIPALITIES OUTSIDE CONSERVATION AUTHORITIES
OPERATION OF FLOOD CONTROL STRUCTURES
MUNICIPALITIES WITHIN CONSERVATION AUTHORITIES
FLOOD WARNING
AREA RESIDENTS MEDIA
SELF HELP AND
EVACUATE PEOPLE AND PROPERTY
SYSTEM COMPONENTS
FLOOD STAGE
A. DATA COLLECTION AND MANAGEMENT
B. STREAMFLOW FORECASTING
C. FLOOD EVENT COMMUNICATION
D. FLOOD EVENT OPERATIONS
FLOOD LEVEL
FLOOD EVENT HYDROGRAPH
TIME

June 12, 1984

A. DATA COLLECTION AND MANAGEMENT	CONSERVATION AUTHORITIES AND WATER MANAGEMENT BRANCH	CONSERVATION AUTHORITIES	MNR REGIONS	MNR DISTRICTS
1. Establishment of Data Monitoring Networks				
(i) Weather Networks	- Liaise and develop communication with AES, MNR Regions & Districts, CAs, Ontario Hydro, Canal Systems and private citizens. - Set criteria & standards for weather networks. - Design networks in conjunction with CAs & MNR Regions. - Approve system for CAs & MNR. - Develop a master plan.	- Implement in conjunction with Reg. & Branch, networks such as precipitation gauges & snow courses.	- Implement in conjunction with CA & Branch, networks such as precipitation gauge & snow courses. - Implement network where no CA exists. - Financial approval & priority setting for CA.	- Operate weather network.
(ii) Hydrometric Networks	- Liaise with Federal & Provincial agencies in the coordination of networks. - Set criteria & standards for CA/MNR. - Approve watershed network for CA/MNR. - Purchase, operate and maintain telemetry equipment for special purposes.	- Implement streamgauge networks, in conjunction with CAMMB & Regions. - Implement and maintain supplementary network. - Implement data logging and telemetry equipment.	- Implement streamgauge networks in conjunction with CAMMB & C.A.'s. - Implement and maintain network where no CAs. - Funding approval & priority setting for CA.	
2. Weather Forecasts	- Obtain WF, GPF, LFM from AES. - Vector precipitation ahead from radar.	- Receive critical WF from CAMMB.	- Receive critical WF from CAMMB.	
3. Data Collection/ Co-ordination/ Transmission	- Develop system for rapid collection, co-ordination, manipulation and transmission of data. - Provide advice on communication systems & equipment to CAs and MNR Regions.	- Collect and quality control data. - Exchange data with CAMMB.	- Collect and quality control data. - Exchange data with CAMMB.	- Collect and quality control data. - Transmit to Region, Fire Mnt Centre or CAMMB.

	CONSERVATION AUTHORITIES AND WATER MANAGEMENT BRANCH	CONSERVATION AUTHORITIES	MNR REGIONS
A. DATA COLLECTION AND MANAGEMENT (Cont'd)			
4. Data Archiving	- Develop and implement system for abstracting, formatting and archiving retrieving data.	- Local quality control	- Local quality control where no CA.
5. Training	- Develop workshops for instrumenation, methods, archiving and retrieval.		
B. STREAMFLOW FORECASTING			
1. Development and Management of Models	- Set standards and criteria. - Assess and adapt existing model. - Develope new models. Maintain models. - Set calibration procedures. - Consultation with CAs and Regions.	- Select model in consultation with C.A.W.M.B. e.g. unit hydrograph - Calibrate hydrograph model to watershed.	- Select model in consultation with C.A.W.M.B. e.g. unit hydrograph - Calibrate hydrograph model to watershed
2. Runoff Forecast	- CAWM Branch will forecast runoff for CAs and Regions. - Research on hydrologic parameters. - Provide consulting services to CA and MNR Regions. - Set standards and criteria.	- Receive runoff forecast. - Adjust to local conditions.	- Where no CA, receive and adjust runoff forecast to local conditions.
3. Hydrograph Forecast	- Research - Consulting services	- Apply runoff to obtain hydrograph forecast.	- Apply runoff to obtain hydrograph forecast.
4. Stage/Damage and Operation Forecasts	- Research - Consulting services	- Develop stage discharge curves. - Develop stage-damage relationships. - Develop operation forecasts for flood control structures.	- Develop stage discharge curves. - Develop stage-damage relationships. - Develop operation forecasts for flood control structures.

	CONSERVATION AUTHORITIES & WATER MANAGEMENT BRANCH	CONSERVATION AUTHORITIES	MNR REGIONS	MNR DISTRICTS	MUNICIPALITIES	AREA RESIDENTS
C. FLOOD EVENT COMMUNICATION						
1. Early Alert	- Provide early alert to CAs and MNR Regions re flood threat. - Develop effective communications system.	- Receive early alert. - Transmit to key personnel.	- Receive early alert. - Transmit to key personnel.			
2. Flood Warning	- Consulting services	- Warn municipalities of flood threat. - Develop communications system.	- Warn MNR Districts & municipalities. - Develop communi-cations system.	- Receive flood warning. - Warn area residents.	- Receive flood warning. - Warn area residents.	- Receive flood warning & take appropriate action.
3. Flood Event Monitoring & Information Exchange	- Monitor event & receive information from CAs & Regions. - Brief senior management (Government).	- Monitor and exchange information - Update on regular basis.	- Monitor and exchange information. - Update on regular basis.			
4. Notice of Event Termination	- Brief senior management (Government).	- Advise municipalities and area residents.	- Advise MNR Districts, municipalities & area residents in areas outside CAs.			